Percent Forest and Woody Wetlands in Stream Buffer

This EnviroAtlas national map portrays the percent forest and woody wetlands within 30 meters of streams, rivers, and other hydrologically-connected waterbodies (e.g., lakes and ponds) within each 12-digit hydrologic unit (HUC). The map layer uses the 2006 National Land Cover Database (NLCD) to define forested land and woody wetlands and excludes agriculture, developed, and barren land.

Why are forested stream buffers important?

Forest and woody wetlands adjacent to streams and rivers, sometimes called the riparian area (or riparian buffer), help protect terrestrial wildlife habitat, aquatic habitat, and water quality. Maintaining forest cover in stream buffers benefits water quality at the site as well as downstream. Land management in upstream areas directly affects the water quality in downstream rivers, bays, and estuaries.

Woody wetlands are defined as areas where forest or shrubland vegetation accounts for > 20% of vegetative cover and the soil is periodically saturated with or covered with water. In EnviroAtlas, woody wetlands include inland freshwater (palustrine) and tidal saltwater (estuarine) forested and shrub-covered wetlands. Woody wetlands add benefit to forested riparian areas by providing large areas of reduced water velocity and saturated organic soil for filtration. Degraded or converted riparian wetlands (e.g., farmed wetlands) are restorable to improve water quality (see Potentially Restorable Wetlands Data Fact Sheet). Restored or constructed woody riparian wetlands provide filtration if placed between the stream and any channelized outflow (e.g., tiled agricultural fields or drainage ditches).[1]

Trees in forested or wetland riparian buffers are capable of slowing and storing floodwater and filtering significant quantities of sediment, nutrients, and heavy metals from agricultural fields and urban stormwater runoff. Studies have shown that sediment removal by trees ranges from 60–90% depending on buffer area, slope, and the volume and velocity of runoff.[2] Toxic substances adhering to sediment particles may be modified by soil microorganisms into less harmful forms and made available to plants. A published review of 66 studies covering nutrient removal by buffer vegetation found that 75% and 90% of excess nitrogen was removed from mean buffer widths of 28 and 112 meters (92 and 367 feet), respectively.[3] Though trees return a significant portion of the nitrogen they remove back to the soil as leaf litter, trees also enable denitrification, a process where bacteria in saturated soil transform dissolved nitrates into gaseous nitrogen compounds that escape to the atmosphere.[1]


Photo: Great egret and cypress trees, NPS Everglades NP

Though the services provided by riparian buffers are clear, determining the optimum widths necessary for riparian buffers to deliver specific benefits and functions (e.g., flood storage, temperature moderation, nutrient filtering) is more difficult. Streams with adjacent intense disturbances require wider buffers.[3] The ability of riparian vegetation to filter pollutants and store floodwater also varies with local climate, buffer width, slope, channelization, and soil permeability. Narrow buffer widths of 5–15 meters (16–49 feet) maintain bank stability and provide some temperature moderation, but they are inadequate for sediment and nutrient reduction.[4] Narrow buffer strips are also subject to flood and wind damage. Maintaining breeding habitat for songbirds and wildlife corridors for the movement of large mammals requires wider buffer widths of 30.5–91.4 meters (100-300 feet, see a table of optimal wildlife corridor widths in the Percent Forest Land in Buffer Data Fact Sheet).[4,1]

Some stakeholders involved in market-based strategies for maintaining water quality have found that it may be less expensive to establish buffers wide enough to accomplish needed functions, compensate land owners for withdrawing land from production, and replant gaps in riparian buffers along stream networks than it is to implement technological fixes for the degradation of water quality. To adequately provide these ecosystem services, it is important to continue to regionally characterize optimal buffer widths and to

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include science in the political and economic discussions surrounding how much natural riparian cover to maintain.

How can I use this information?

This map layer indicates which 12-digit HUCs may benefit from riparian buffer restoration projects to improve water quality. An area can be more thoroughly investigated by increasing the transparency on this map and adding data for streams and water bodies (NHD) from Supplemental Maps to an aerial imagery base map. Detailed examination shows land cover along streams and reveals where upstream areas may be contributing to problems in downstream communities. Many states have developed guidelines for riparian buffer best management practices (BMPs) and recommended buffer widths.

How were these data created?

These data were generated by using the 2006 National Land Cover Dataset (NLCD) and high resolution (1:24,000 or higher) National Hydrography Data (NHD) depicting stream lines and water bodies in the landscape assessment tool, Analytical Tools Interface for Landscape Assessments (ATtILA). ATtILA is an Esri ArcView extension created by EPA that calculates many commonly used landscape metrics, including land cover adjacent to streams.

The 30-meter stream buffers for this group of EnviroAtlas metrics were created by delineating a polygon one-pixel wide (30 meters) on either side of a stream network and around the perimeter of hydrologically-connected lakes or ponds. The percentage of NLCD forest and woody wetland cover within the buffer was recorded for each 12-digit HUC. Waterbodies not hydrologically connected within a drainage network were not included in the analysis. For more information on this calculation, see the ATtILA User's Manual.

What are the limitations of these data?

The landcover classes found in NLCD are created through the classification of satellite imagery. Human classification of landcover types that have a similar spectral signature can result in classification errors. As a result, NLCD is a best estimate of actual landcover. Also, because of its 30m pixel size, NLCD may miss riparian buffers that are <30m wide.

A national-scale metric such as this gives an overview of the extent of forest and woody wetland within a fixed-distance buffer summarized by 12-digit HUCs. However, at any point along a stream network, riparian areas may be narrower or wider than the fixed-distance buffer. Fixed-distance buffers cannot account for differences among buffer areas because of gaps in riparian vegetation, upslope sources of pollutants, or upslope forested areas.[5] They do not reflect upstream-downstream patterns of watershed land cover, differences between forested and unforested stream banks, or flowpaths for runoff influenced by local topography.[5] A full research effort, one that considered variable buffer widths, would be required to get an accurate local estimate of riparian vegetation filtering capabilities within or among watersheds.

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. The NLCD and NHD data are accessible through their respective websites.

Where can I get more information?

A selection of resources related to riparian buffers is listed below. For additional information on how the data were created, access the metadata for the data layer from the drop down menu on the interactive map table of contents and click again on metadata at the bottom of the metadata summary page for more details. To ask specific questions about this data layer, please contact the EnviroAtlas Team.

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Selected Publications

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